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<p>(54) Title: CABLE ATTACHMENT FOR A LUMBAR SUPPORT</p> <p>(57) Abstract</p> <p>A lumbar support mechanism (210) includes a flexible support member (212), a spring (216) and a cable assembly (214). The flexible support member has oppositely disposed first (222) and second ends (220). The spring has a first end (228) and a second end (230). The first end of the spring is connected to one of the first end and second ends of the flexible support member. The cable assembly includes a sleeve (234) and a cable (232) slidably disposed therein. The sleeve has a first end connected to the second end of the spring. The cable has a first end connected to the other of the first and second ends of the flexible support member.</p>		

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## **CABLE ATTACHMENT FOR A LUMBAR SUPPORT**

This application is a continuation in part of U.S. Patent Application Serial No 08/815,374 filed on March 10, 1997 which is a continuation in part of U.S. Patent Application Serial No. 08/606,257, filed on February 23, 1996, and issuing as U.S. Patent No. 5,609,394 on March 11, 1997.

### **Field of the Invention**

The present invention relates to lower back or lumbar supports for seats, and more particularly to adjustable lumbar supports used in seatbacks.

### **Background of the Invention**

Lumbar supports employing Bowden type cable assemblies as part of a means of adjusting the lumbar support commonly attach both the cable and the cable sleeve directly to the flexible support member. This can result in a high level of stress being induced in the flexible support member, particularly when the lumbar support is subjected to an impact load.

It is desired to provide a lumbar support employing a Bowden type cable assembly as part of the adjustment mechanism in which the connection between the cable assembly and the flexible support prevents the development of a high level of stress within the flexible support member when the lumbar support is subjected to an impact load.

### **Summary of the Invention**

A lumbar support mechanism includes a flexible support member, a spring and a cable assembly. The flexible support member has oppositely disposed first and second ends. The spring has a first end and a second end. The first end of the spring is connected to one of the first end and second ends of the flexible support member. The cable assembly includes a sleeve and a cable slidably disposed therein. The sleeve has a first end connected to the second end of the

spring. The cable has a first end connected an other of the first and second ends of the flexible support member.

A lumbar support mechanism includes a flexible support member, a spring and a cable assembly. The flexible support member has oppositely disposed first and second ends and is flexible between a fully bowed condition and a relaxed condition wherein the first and second ends are closer to each other in the bowed condition that in the relaxed condition. The spring has first and second ends. The first end of the spring is connected to one of the first and the second ends of the flexible support member. The cable assembly includes a sleeve and a cable slidably disposed therein. The sleeve has a first end connected to the second end of the spring. The cable has a first end connected to an other of the first and second ends of the flexible support member. The spring has an elastic operating range sufficient to accommodate displacement of the first end of the flexible support member relative to the second end of the flexible support member from the fully bowed condition to the relaxed condition without yielding the spring and without any relative cable to sleeve displacement.

The disclosed lumbar support mechanism employs a Bowden type cable assembly as part of the adjustment mechanism with a connection between the cable assembly and the flexible support member which prevents the development of a high level of stress within the flexible support member when the lumbar support is subjected to the an impact load.

These and other features of the present invention will become apparent to one skilled in the art from the following detailed description and the appended drawings.

### **Brief Description of the Drawings**

Figure 1 is a perspective view of a four-way lumbar support in a seatback frame.

Figure 2 is a rear view of the four-way lumbar support and seatback frame of Figure 1.

Figure 3 is a side view of the four-way lumbar support of Figure 1 adjusted to provide minimal lumbar support.

Figure 4 is a side view of the four-way lumbar support of Figure 1 adjusted to provide maximum lumbar support at a first or lowest apex vertical position.

Figure 5 is a side view of the four-way lumbar support of Figure 1 adjusted to provide maximum lumbar support with the apex adjusted to a second or maximum vertical position.

Figure 6 is a rear view of a two-way lumbar support in a seatback frame employing a first alternative means for connecting the cable to the support member.

Figure 7 is a side view of the lumbar support of Fig. 6 in the direction of arrows 7.

Figure 8 is a rear view of a two-way lumbar support in a seatback frame employing a second alternative means for connecting the cable to the support member.

Figure 9 is a side view of the lumbar support of Fig. 8 in the direction of arrows 9.

Figure 10 is a rear view of a two-way lumbar support in a seatback frame employing a third alternative means for connecting the cable to the support member.

Figure 11 is a side view of the lumbar support of Fig. 10 in the direction of arrows 11.

Figure 12 is a rear view of a two way lumbar support in a seatback frame and in an undeflected condition employing a fourth alternative means for connecting the cable to the support member.

Figure 13 is a side view of the lumbar support of Fig. 12 in the direction of arrow 13.

Figure 14 is a side view of the lumbar support of Fig. 13 in a deflected or bowed condition.

Figure 15 is a side view of the lumbar support of Fig. 14 with a force acting against the bowed lumbar support.

### **Detailed Description of a Preferred Embodiment**

A four-way lumbar support 10 as shown in Figures 1 and 2 is supported by a seatback frame 12 having a first or lower horizontally disposed bar 14 and a second or upper horizontally disposed bar 16 engaging opposite ends of four-way lumbar support 10. A flexible single piece support member 18 is engaged by means for longitudinally subtending 20 and an apex shift mechanism 22.

The single piece support member 18 has a central body 24 with a first or lower longitudinal end 25 pivotably attached to first horizontally disposed bar 14, and a second longitudinal end 26 slidably engaging second horizontally disposed bar 16. Four support fingers 27 extend transversely outwardly from each side of central body 24. Of course support member 18 may have more or fewer support fingers 27 depending upon the specific seat configuration. First longitudinal end 25 includes an inside clamping member 28 and outside clamping member 30, best shown in Figures 2 and 3. Inside clamping member 28 and outside clamping member 30 deflect from a first position, shown in phantom in Fig. 3, to receive first horizontally disposed bar 14 and deflect to the second position, shown in solid lines, trapping bar 14 and thereby providing pivotable engagement between first longitudinal end 25 and first horizontally disposed bar 14.

Second longitudinal end 26 has inside holding member 32 and outside holding members 34 engaging second horizontally disposed bar 16. Inside holding member 32 and outside holding members 34 are spaced apart from each other as shown in Figures 3-5 a distance approximately equal to a diameter of second horizontally disposed bar 16, enabling sliding movement of second

longitudinal end 26 relative to second horizontally disposed bar 16 a distance approximately equal to the length of outside holding member 34.

A subtending yoke 36 has a lower side 37 passing through an aperture in a bottom anchor 38 which is fixed to inside clamping member 28, thereby pivotably attaching yoke 36 to support member 18. Subtending yoke 36 has an engaging hook 39 on one side which engages a free end of lower side 37 to enable both sides of yoke 36 to react against lower side 37 when the yoke sides are in tension.

A Bowden-type subtending cable assembly 40 engages a U-shaped slot 41 in yoke 36 with a cable end 42 of a subtending cable 43. A subtending cable housing or sheathing 44 encloses a portion of subtending cable 43 and extends from a first reinforcing sleeve 46 engaging a tab 48 of inside holding member 32 to an actuator housing 50 including an electric drive motor 52.

Apex shift mechanism 22 includes an apex shift linkage 54 having an H-shaped first shift link 56 pivotably connected at a hinge point to a Y-shaped second shift link 58. A lower portion of first shift link 56 straddles bottom anchor 38 and has a first aperture 60 which receives lower side 37 of yoke 36. Free end of lower side 37 is removed from connecting hook 39 and passes through the aligned first aperture 60 and bottom anchor aperture to pivotably connect first shift link 56 with support member 18. An upper portion of first shift link 56 captures a lower end of second shift link 58 and has a second aperture 62 aligned with a first aperture 64 through the lower end of second shift link 58. A pin 66 passing through apertures 62 and 64 defines the hinge point or rotational joint between first and second shift links 56 and 58. The rotational joint can alternatively be provided any other suitable structure, such as a snap-in feature with a pair of engaging bumps and dimples. A reinforcing stamping 68 fixed to support member 18 includes a snap mount 70 which receives an upper pin 72 disposed between open arms of second shift link 58 for pivoting within the snap mount 70.

A cable aperture in second shift link 58 located opposite the hinge point from support member 18 receives a cable housing 78 of a Bowden-type apex shift cable assembly 80. Cable

housing 78 extends to an apex shift actuator housing 81. An apex shift cable 82 is disposed within cable housing 78 and extends beyond cable housing 78 to engage a molded cable anchor 83 fixed to support member 18 which receives a cable end 84. Molded cable anchor 83 is fixed to support member 18 at a location between bottom anchor 38 and snap mount 70 and proximate to a preformed bend 88 in support member 18 bowing outward away from apex shift linkage 58. An exposed length of cable 82 extending beyond cable housing 78 to cable end 84 is varied in length by actuator 81 with the energization of an electric drive motor 86.

The two actuator/drive motor combinations, 50, 52 and 81, 86 are mounted to the lowermost of the support fingers 27 in the embodiment shown. However, it is anticipated that the actuator/drive motor combinations could be mounted elsewhere, as may be required for the particular seat into which the lumbar support is to be placed. While electric drive motors are shown in the present embodiment, it should be appreciated that other drive means, such as hand operated cable displacement mechanisms, can be substituted.

The four-way lumbar support operates in the following manner. The four-way lumbar support 10 as shown in Figure 3 is effectively providing no enhancement of lumbar support. Support member 18 is essentially undeflected from its unloaded shape. By displacing cable 43 to shorten the length of cable 43 disposed between the U-shaped slot 41 in yoke 36 and the cable housing 44, support member 18 bows outward, defining an outermost point, or apex 90 at the support finger 27 which is second from the top. It is understood that the precise location of apex 90 is merely exemplary and will vary with the specific design of the lumbar support 10. As the exposed cable length is shortened, second longitudinal end 26 slides along second horizontally disposed bar 16 as first longitudinal end 25 pivots about first horizontally disposed bar 14 until second horizontally disposed bar 16 is engaged by tab 48 to prevent further displacement.

The apex 90 is shifted upward and made more pronounced by shortening the length of exposed cable 82. Energization of drive motor 86 results in a shortening of the portion of apex shift cable 82 exposed between cable housing 78 and molded cable anchor 83. The change in length occurs with the pivoting of first shift link 56 relative to second shift length 58, increasing



the angle therebetween and likewise increasing a distance between bottom anchor 38 and snap mount 70 which tends to straighten out a stamped or preformed bend 88.

The amount of bowing can be varied between the minimum and maximum shown in Figures 3 and 4 respectively by merely varying the displacement of cable 43 adjusting the exposed length of cable 43 to an intermediate length to provide the amount of bowing desired. Reversal can be achieved by reversing the change in exposed cable length. Similarly, the adjustment of the location of apex 90 can be controlled between that shown in Figures 4 and 5 by controlling the exposed length of cable 82. The apex 90 is shifted upward by shortening the exposed length of cable 82. The apex is shifted downward by increasing the exposed length of cable 82.

It should be appreciated that the means for attaching the subtending cable can be varied from that shown in Figs. 1-5. Four alternative means are shown in use with two-way lumbar supports in Figs. 6-15.

A first cushioning yoke 92 is shown in Figs. 6 and 7 as an alternative to subtending yoke 36A in a two-way lumbar support 94. Cushioning yoke 92 has the shape of an elongated rectangle and is fixed at a lower end by rivets 96 to a lower end of the support member 98. Cushioning yoke 92 has a rectangular aperture 100 centered therein to accommodate installation of apex shift mechanism 22, enabling conversion of two-way lumbar support 94 to a four-way lumbar support. Cushioning yoke 92 has a plurality of wave shaped undulations 101 formed along its length. Approximately  $1\frac{1}{2}$  wavelengths are formed by undulations 101.

A Bowden-type cable assembly 102 having an outer sleeve 104 with a cable 106 slidably disposed therein extends from a displacement mechanism 103 to support member 98. Sleeve 104 terminates in an engagement block 108 formed at an end of sleeve 104. Engagement block 108 is received by a pocket portion 110 of an upper portion of support member 98. Cable 106 passes out through engagement block 108 and a slot 112 through pocket portion 110. A portion of engagement block 108 passes through slot 112 to keep block 108 centered in pocket portion 110. An enlarged cable end 114 is received by a hook portion 116 at the top of yoke 92. As long as

cable 106 is maintained in tension, engagement block 108 and cable end 114 will remain firmly seated in pocket portion 110 and hook portion 116 respectively.

The lower portion of support member 98 is pivotably attached to lower bar 14 in substantially the same manner as support member 18. The outside clamping members 30 have each been narrowed, and a pair of back-up tabs 118 have been added between the inside and outside clamping members. Back-up tabs 118 help maintain bar 14 in its desired position relative to clamping members 30 and 28.

The upper portion of support member 98 is slidably disposed over upper bar 16. The upper portion of support member 98 has a pair of outer members 120 with engaging beads 122 which stiffen outer members 120 and present a minimum contact area surface to bar 16. Retention of outer members 120 against bar 16 is ensured by a retention tongue 124 which projects rearward from the top of support member 98 a distance approximately equal to the diameter of bar 16, and then extends downward parallel to engaging beads 122, to enclose bar 16 therebetween. Pocket portion 110 is disposed at a lower end of a U-shaped section which wraps around retention tongue 124.

Displacement mechanism 103 employs a lead screw (not shown) rotatably displaced by rotation of a handwheel 128 to produce axial displacement of cable 106. It should be readily apparent that a motorized drive system can be substituted for displacement mechanism 103.

The system of Figs. 6 and 7 operates in the following manner. Support member 98 is shown in an essentially undeflected shape in Fig. 7, providing minimal lumbar support. Handwheel 128 is rotated in a first direction to increase the amount of lumbar support provided. As cable 106 is retracted, the distance between pocket portion 110 and hook portion 116 decreases, resultantly causing support member 98 to increasingly bow outward. Coincident with this increased bowing, the upper portion moves downward, with beads 122 sliding downward on bar 16. When the desired amount of lumbar support is achieved, then handwheel 128 is released. When a decrease in lumbar support is desired, handwheel 128 is merely rotated in a direction opposite the first direction.

Although the undulations 101 in yoke 92 will tend to straighten as the apex is shifted further outward, the principle benefit of the undulations 101 is in reducing the stress on the lumbar support associated with unusually high loading against the lumbar support, such as impact loading. Impact loadings occur in rear-impact collisions. When an occupied seat is suddenly accelerated forward, as in a rear impact, the occupant is pushed back into the seat and against the lumbar support. It is highly desirable that the lumbar support maintain its functionality after sustaining an impact, yet provide some flexibility to reduce loading stresses at the pocket portion 110 and hook portion 116. The cushioning yoke achieves the objective of reducing the stresses for impact loading conditions.

A second alternative means for attaching the subtending cable 102 shown in Figs. 8 and 9 is substantially the same as that shown in Figs. 6 and 7, except that the cable and sleeve ends, 116 and 108 respectively, and their associated retention features 110 and 116, are reversed with respect to support member 98 and yoke 92. Whether the cable sleeve is oriented to come from above, as shown in Figs. 6 and 7, or from below, as shown in Figs. 8 and 9, is a matter of design choice, largely controlled by packaging parameters.

A third alternative means for attaching the subtending cable 102 shown in Figs. 10 and 11 is also substantially like that shown in Figs. 6 and 7, except that no yoke is provided. Cable 106 instead has a hook 103 which passes through a notch 132 in clamping member 28 to directly engage bar 14. While this configuration does not have the cushioning effect associated with yoke 92, it achieves an improved distribution of forces to minimize the localized stress at the point of attachment of cable 106 to support member 98. By using hook 130 to engage bar 14, the load in cable is distributed across clamping member 28 instead of a localized point.

A fourth alternative means for attaching a subtending cable is shown in Figs. 12 through 15. A lumbar support mechanism 210 includes a flexible support member 212 substantially the same as support members 18 and 98, a Bowden-type subtending cable assembly 214, a restoring spring 216 and an actuator 218 with a handwheel 219.

The flexible support member 212 can be formed of sheet metal or plastic. Flexible support member 212 has a lower end 220 which pivotably clips to lower bar 14. An upper end 222 of flexible support member 212 slidably engages upper bar 16.

Restoring spring 216 is formed of spring wire 224. A coil portion 226 of spring 216 defines a center passage 227. A first end 228 of spring 216 includes a hook shaped first attachment feature 229 which engages lower bar 14. It should be appreciated that attaching feature 229 may have alternative shapes and that it may engage lower end 220 directly as well as indirectly, or may engage some intermediate feature, such as yoke 36 of Figs. 1-4. A second end 230 of spring 216 has a second attaching feature 231.

Cable assembly 214 has a cable 232 slidably disposed within a cable sleeve 234. A first end 236 of cable 232 has a substantially S-shaped engaging hook 237 connecting first end 236 with upper end 222 of flexible support member 212. A second end of cable 232 is not shown, as it is disposed within a housing of actuator 218.

A first end 238 of sleeve 234 connects to second end 230 of spring 216. A plastic block 239 is disposed at first end 238 of sleeve 234 and is engaged by second attachment feature 231. Plastic block 239 helps distribute the reaction load between sleeve 234 and second attachment feature 231. A second end 240 of sleeve 234 engages the actuator housing.

A felt silencing pad 250 is applied to flexible support member 212 on a rear side in alignment with cable 232 and spring 216 to prevent any direct contact between flexible support member 212 and both cable 232 and spring 216. Felt silencing pad 250 serves to both prevent wear between the parts and to prevent the generation of noise by direct contact between support member 212 the subtending parts 214, 216.

Actuator 218 includes an axially fixed screw drive (not shown) fixed to handwheel 219 for rotation therewith. A non-rotating actuator nut is disposed on the screw. Rotation of handwheel 219 rotates the screw, causing the nut to be axially displaced within the housing. The second end of cable 232 engages the actuator nut for axial movement therewith. By rotating

handwheel 219, the second end of cable 232 is displaced within sleeve 234, and first end 236 of cable 232 moves relative to first end 238 of sleeve 234.

Spring 216 is configured, by the appropriate selection of the diameter of wire 224, the material of wire 224, the diameter of the coil portion, and the number of coils to provide both an advantageous spring rate and an advantageous preload. The preload is the tensile load which must be applied to spring 216 to achieve a separation of the coils of spring 216. The advantageous preload is selected so that spring 216 does not deflect significantly during normal operating conditions. The spring is configured to provide a large amount of spring travel, or elastic operating range, or deflection, approximately 2 inches of travel in one preferred embodiment, without yielding. The available spring travel of spring 216 substantially equals or exceeds the difference in the distance between lower end 220 and upper end 222 in an undeflected condition and in a fully deflected condition. Exemplary spring rates and preloads are: 75 pounds per inch and 30 pounds, respectively. Corresponding exemplary springs have a wire diameter of .102 inches, an outside coil diameter of .525 inches and 20.5 active coils.

The embodiment of Figs. 12 and 13 operates in the following manner. Flexible support member 212 is moved between a deflected condition as illustrated in Fig. 13 and an undeflected condition as illustrated in Fig. 14. Spring 216 remains substantially undeflected with the deflection of flexible support member 212 in an unoccupied seat. As cable 232 is displaced within cable sleeve 234 by actuator 218 or some alternative actuator, the distance between upper end 222 and lower end 220 of support member 212 changes, causing flexible support member to bow or deflect accordingly.

Spring 216 remains essentially undeflected through the range of travel of cable 232 with an unoccupied seat. The normal force of an occupant against the lumbar support member 212 may cause the deflected profile of support member 212 to alter without significantly deflecting spring 216. However, when a load against the lumbar support illustrated by arrow F in Fig. 15 is sufficiently high, the resultant load on spring 216 is sufficient to overcome the spring preload. Load F distorts the shape of support member 212 as in Fig. 15. As a result of load F, spring 216 deflects, with the distance between deflection of upper end 222 and lower end 220 increasing.

The spring deflection and the associated mode of deflection of support member 212 is particularly advantageous in certain overload conditions, as may be experienced when an occupant of the seat is pushed back into the seat by a sudden acceleration or impact. Spring 216 deflects to allow the first end 238 or sleeve 234 to float or move upward, thereby enabling upper end 220 to shift upward. The movement of first end 238 limits the amount of tensile load in the actuating system, while spring 216 provides a restoring force which, when the overload Force  $F$  is reduced or eliminated, tends to restore support member 212 to its preoverload shape as shown in Fig., 14. The large amount of deflection available to spring 216 allows spring 216 to serve as a self-restoring fuse in lumbar support mechanism 210. By comparison, a spring with relatively little available extension length would yield to the point of changing its free length, and would be unable to restore support member 212 to its preoverload shape. Also, springs with inadequate spring rates or preloads would also, in some circumstances, be inadequate to return support member 212 to its original shape.

The location of spring 216 between first end 238 of sleeve 234 and lower end 220 advantageously allows spring 216 to be easily packaged within lumbar support mechanism 210, in spite of its long length (approximately 6 inches). An additional advantage presented by the routing of cable assembly 214 through coil portion 226 is that cable assembly is restricted from excess movement, minimizing noise, vibration and rattle concerns associated with packaging lumbar support mechanism 210 within a seat which is to be used in a motor vehicle.

The preceding description is exemplary rather than limiting in nature. A preferred embodiment was disclosed to enable a skilled artisan to practice the invention. Modifications are possible without departing from the scope of the present invention, which is limited only by the following claims.

## Claims

We claim:

1. A lumbar support mechanism comprising:  
a flexible support member having oppositely disposed upper and lower ends;  
a spring having a first end and a second end with the first end connected to the lower end of the flexible support member; and  
a cable assembly having a sleeve and a cable slidably disposed therein, the sleeve having a first end connected to the second end of the spring and the cable having a first end connected to the upper end of the flexible support member wherein displacement of the cable relative to the sleeve in a first direction causes the flexible support member to bow and displacement of the cable relative to the sleeve in a second direction allows the flexible element to straighten and further wherein the spring deflects responsive to a force against the flexible support member when the flexible support member is in a deflected condition, causing relative displacement between the upper end and the lower end of the flexible support member.
2. A lumbar support mechanism as claimed in claim 1 wherein the spring has an elastic operating range of length sufficient to enable relative movement between the upper and lower ends of the flexible support member from positions corresponding to a full deflected condition to positions corresponding to an undeflected condition of the flexible support member.
3. A lumbar support member as claimed in claim 1 wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.
4. A lumbar support member as claimed in claim 2 wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

5. A lumbar support mechanism comprising:  
a flexible support member having oppositely disposed first and second ends;  
a spring having a first end and a second end with the first end being connected to one of the first and the second ends of the flexible support member; and  
a cable assembly having a sleeve and a cable slidably disposed therein, the sleeve having a first end connected to the second end of the spring and the cable having a first end connected to an other of the first and second ends of the flexible support member.

6. A lumbar support mechanism as claimed in claim 5 wherein the spring has an elastic operating range of length sufficient to enable relative movement between the upper and lower ends of the flexible support member from positions corresponding to a fully bowed condition to positions corresponding to an undeflected condition of the flexible support member.

7. A lumbar support mechanism as claimed in claim 5 wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

8. A lumbar support mechanism as claimed in claim 6, wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

9. A lumbar support mechanism comprising:  
a flexible support member having oppositely disposed first and second ends, the flexible support member being flexible between a bowed condition and a relaxed condition wherein the first and second ends are closer to each other in the bowed condition than in the relaxed condition;

a spring having a first end and a second end with the first end being connected to one of the first end and second ends of the flexible support member and the spring having a coil portion substantially defining an elastic operating range sufficient to accommodate displacement of the



first end of the flexible support member relative to the second end of the flexible support member from the fully bowed condition to the relaxed condition without yielding the spring; and

a cable assembly having a sleeve and a cable slidably disposed therein, the sleeve having a first end connected to the second end of the spring and the cable having a first end connected to an other of the first and second ends of the flexible support member, wherein, with the cable and the sleeve in a fixed relationship relative to each other, a predetermined load imposed against the flexible support member induces a load against the spring and the predetermined load tends to flatten the flexible support member, thereby separating the first and second ends of the flexible support member responsive to the deflection of the spring, thereby elongating the coil portion.

10. A lumbar support mechanism as claimed in claim 9, wherein the spring has an elastic operating range of length sufficient to enable relative movement between the upper and lower ends of the flexible support member from positions corresponding to the fully bowed condition to positions corresponding to an undeflected condition of the flexible support member.

11. A lumbar support mechanism as claimed in claim 9 wherein the coil portion has a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

12. A lumbar support mechanism as claimed in claim 10 wherein the coil portion has a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

13. A lumbar support mechanism comprising:  
a flexible support member having oppositely disposed first and second ends;  
a spring having a first end and a second end with the first end being connected to the flexible support member;

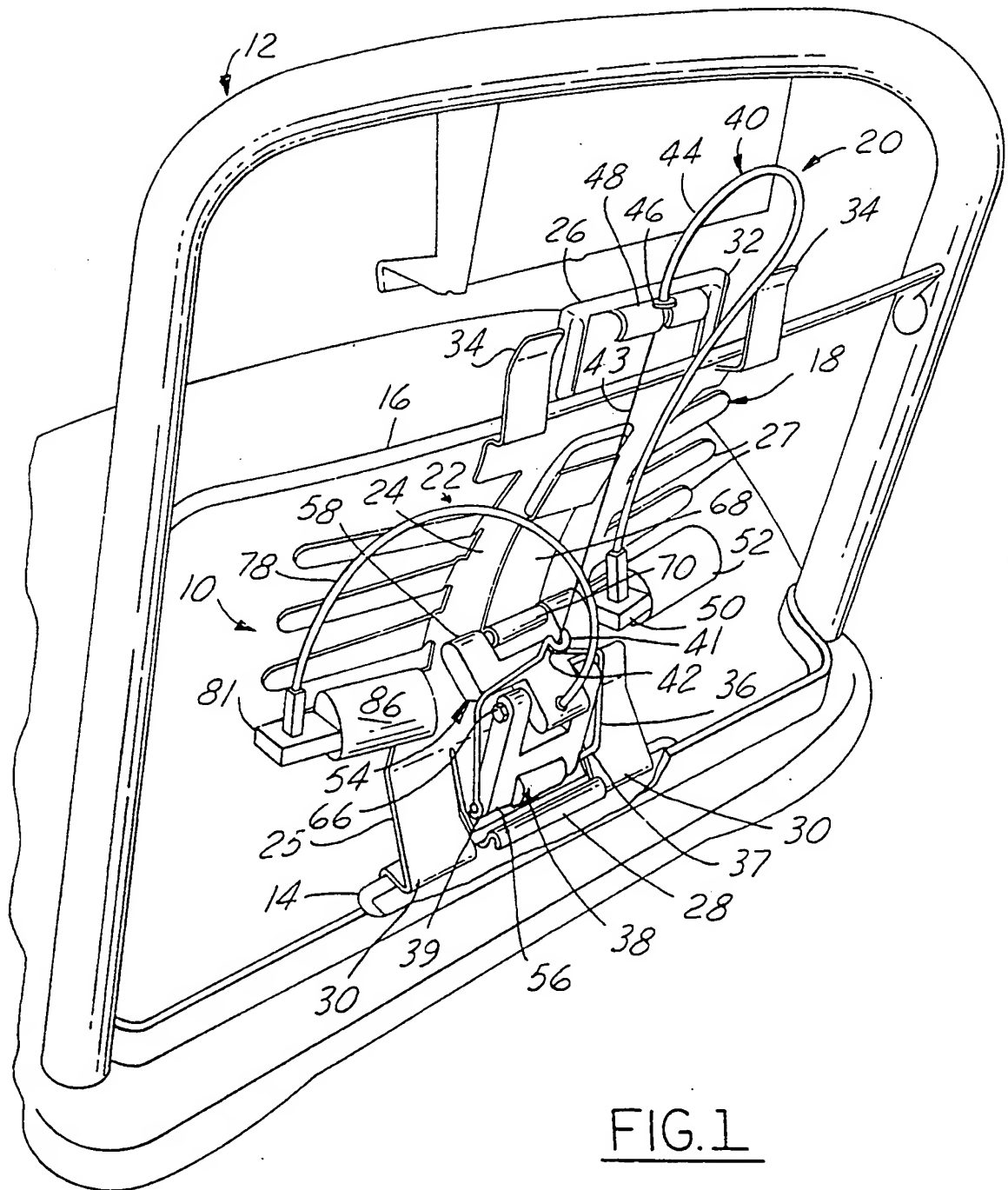
a cable assembly having a sleeve and a cable slidably disposed therein, the sleeve having a first end connected to the second end of the spring and the cable having a first end connected to the flexible support member.

14. A lumbar support mechanism as claimed in claim 13 wherein the spring has an elastic operating range of length sufficient to enable relative movement between the upper and lower ends of the flexible support member from positions corresponding to a fully bowed condition to positions corresponding to an undeflected condition of the flexible support member.

15. A lumbar support mechanism as claimed in claim 13 wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

16. A lumbar support mechanism as claimed in claim 14, wherein the spring is a coil spring defining a center passage and the first end of the sleeve extends through the center passage toward the second end of the spring, the spring thereby aiding in maintaining the sleeve in a desired orientation.

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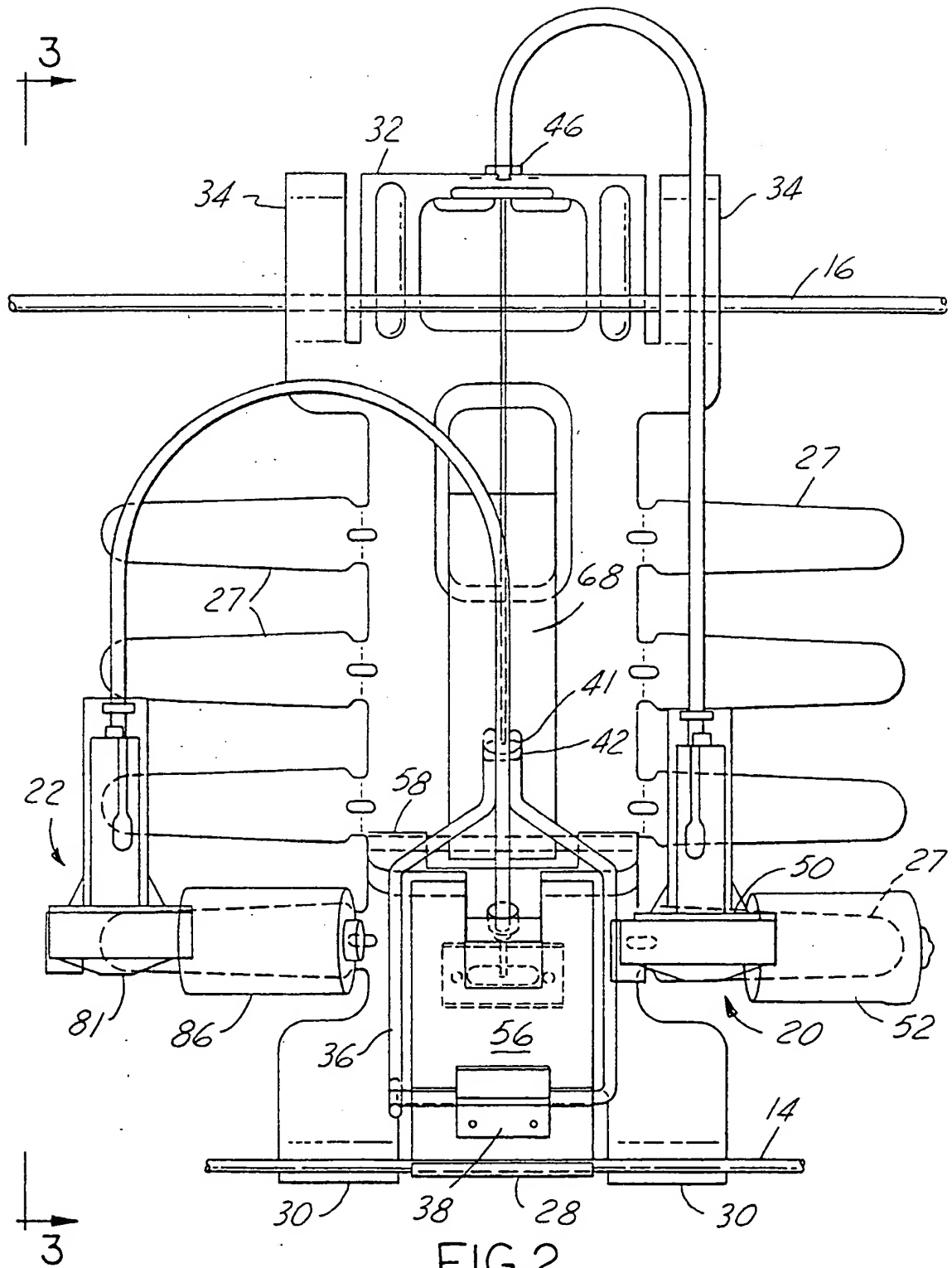
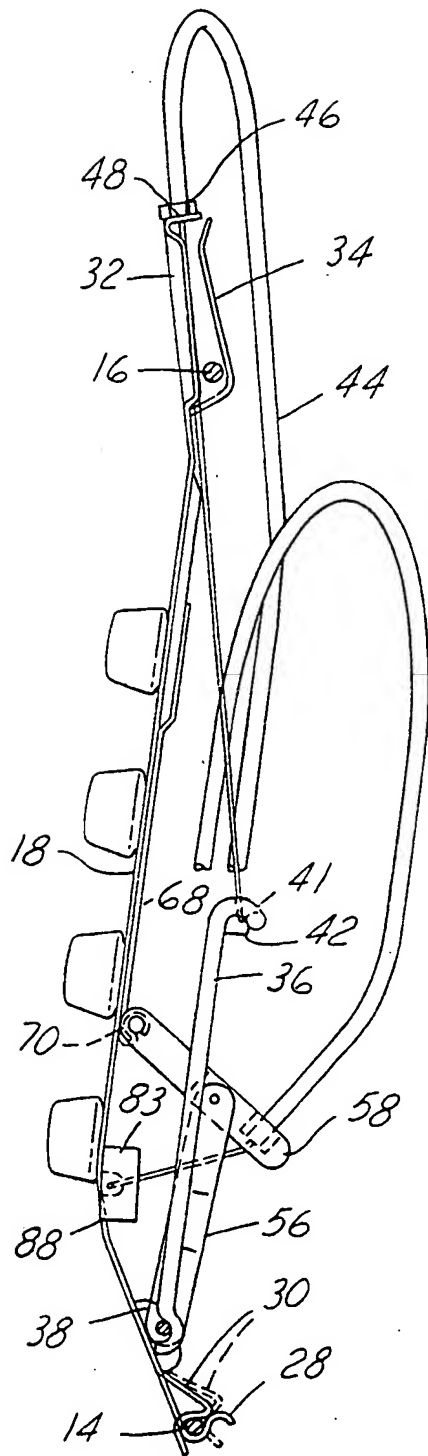
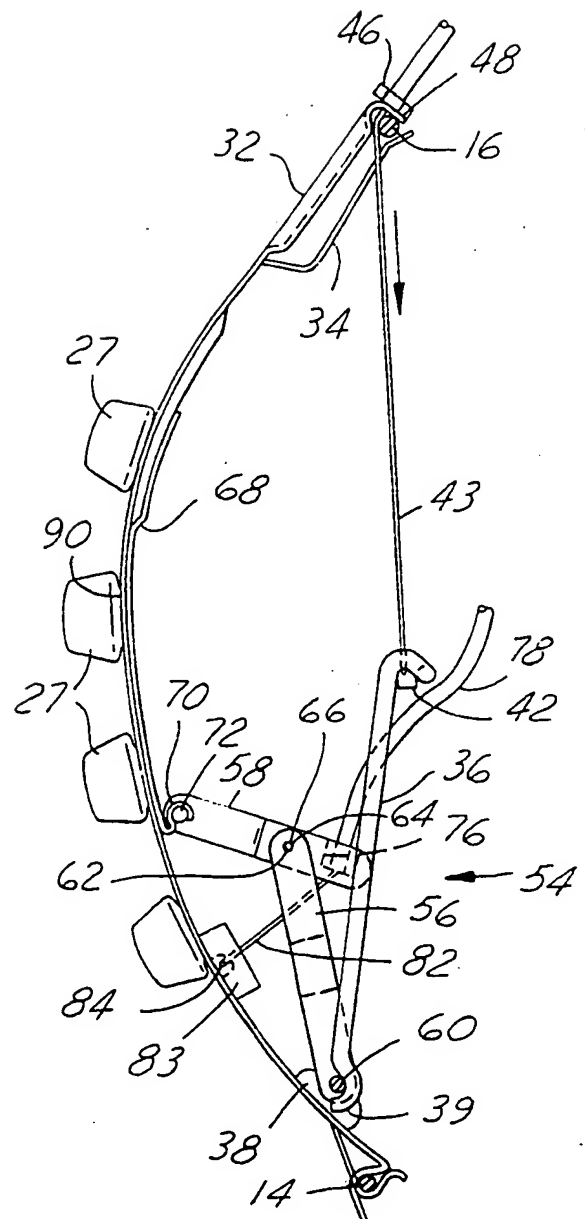


FIG. 2

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FIG. 3FIG. 4

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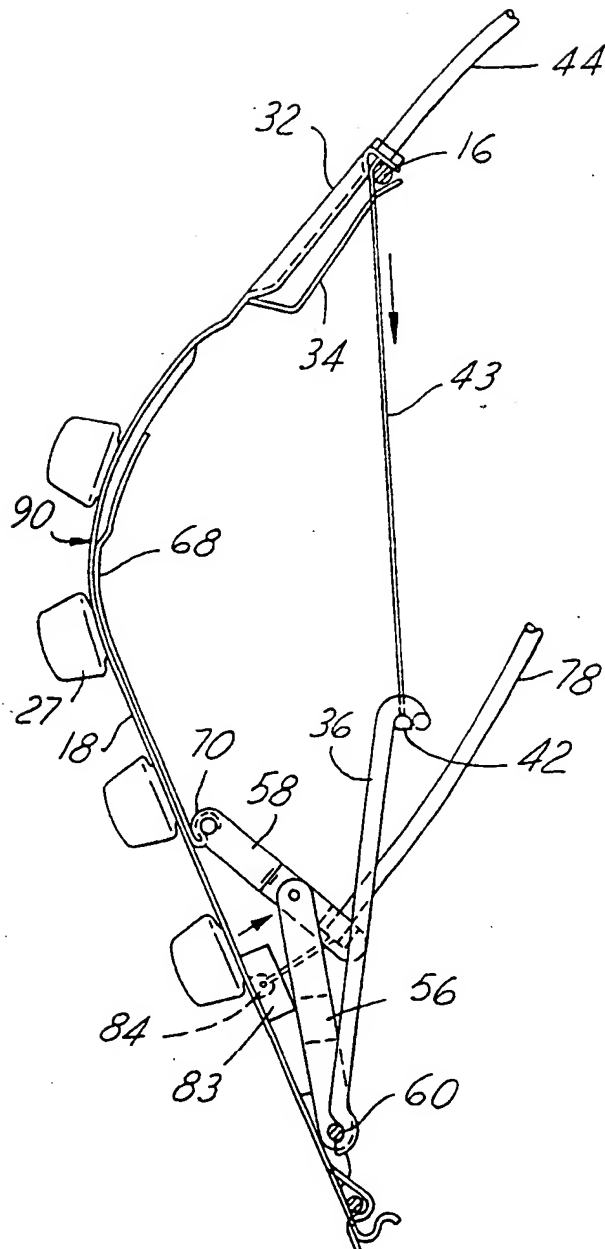


FIG. 5

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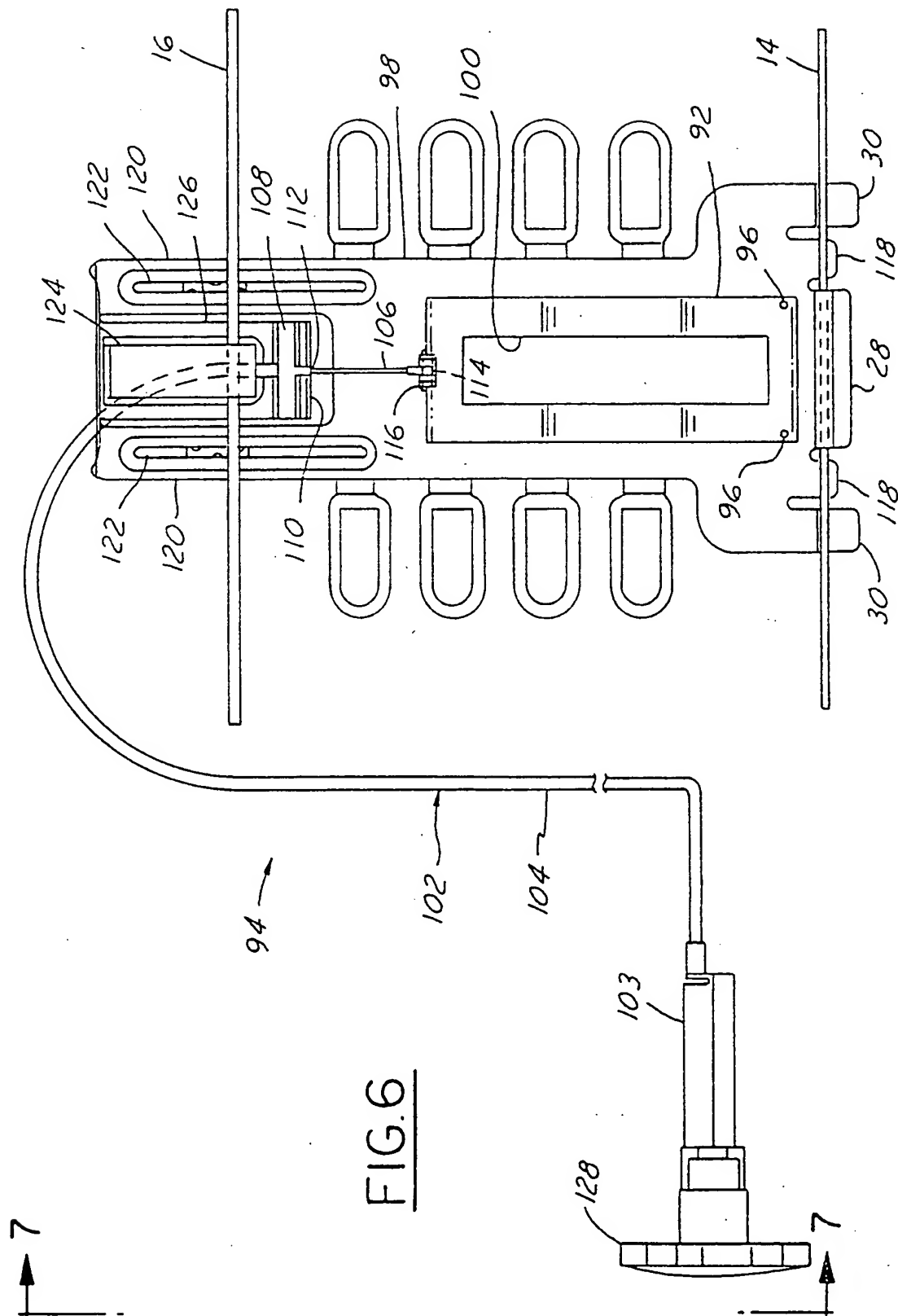


FIG. 6





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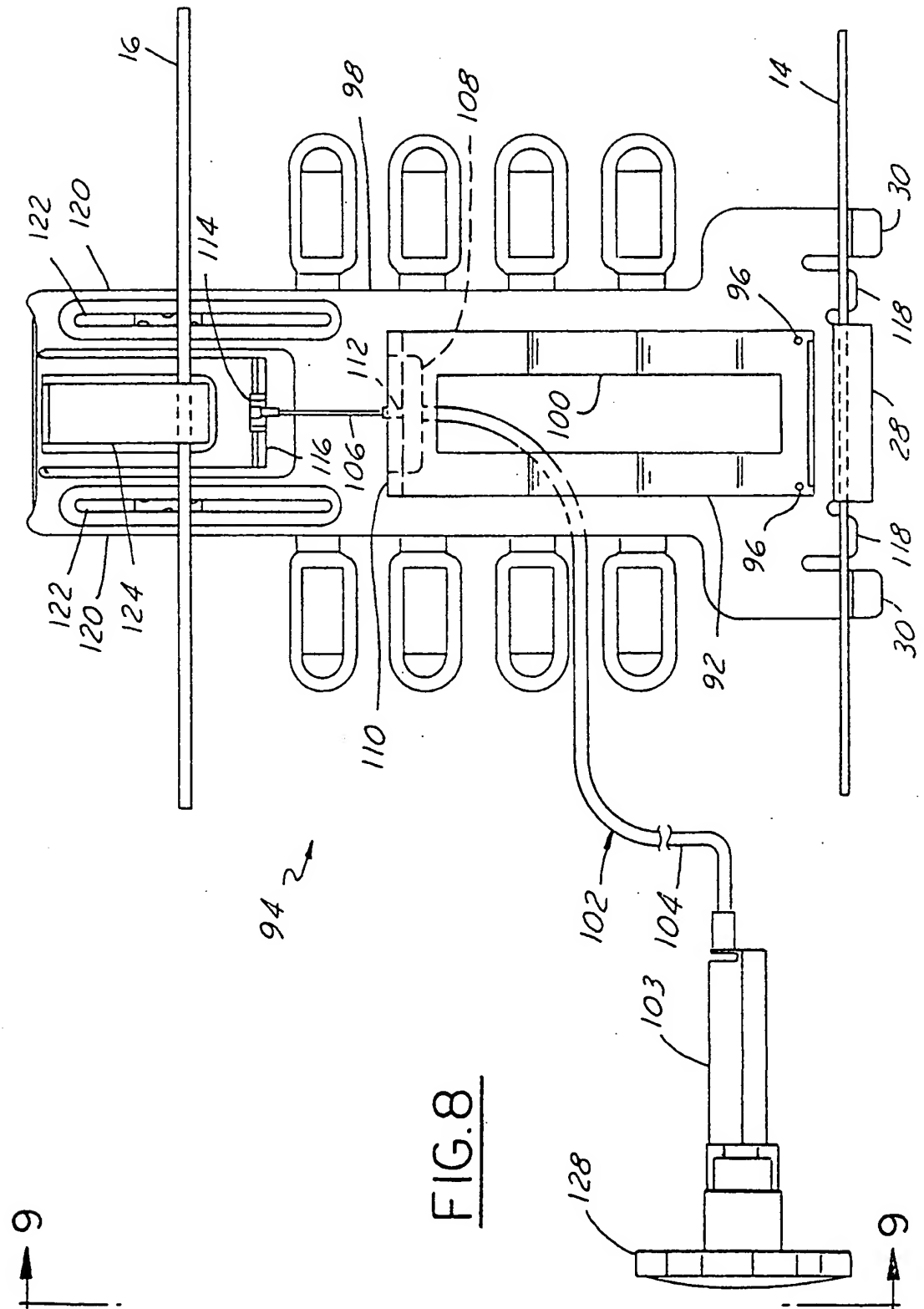
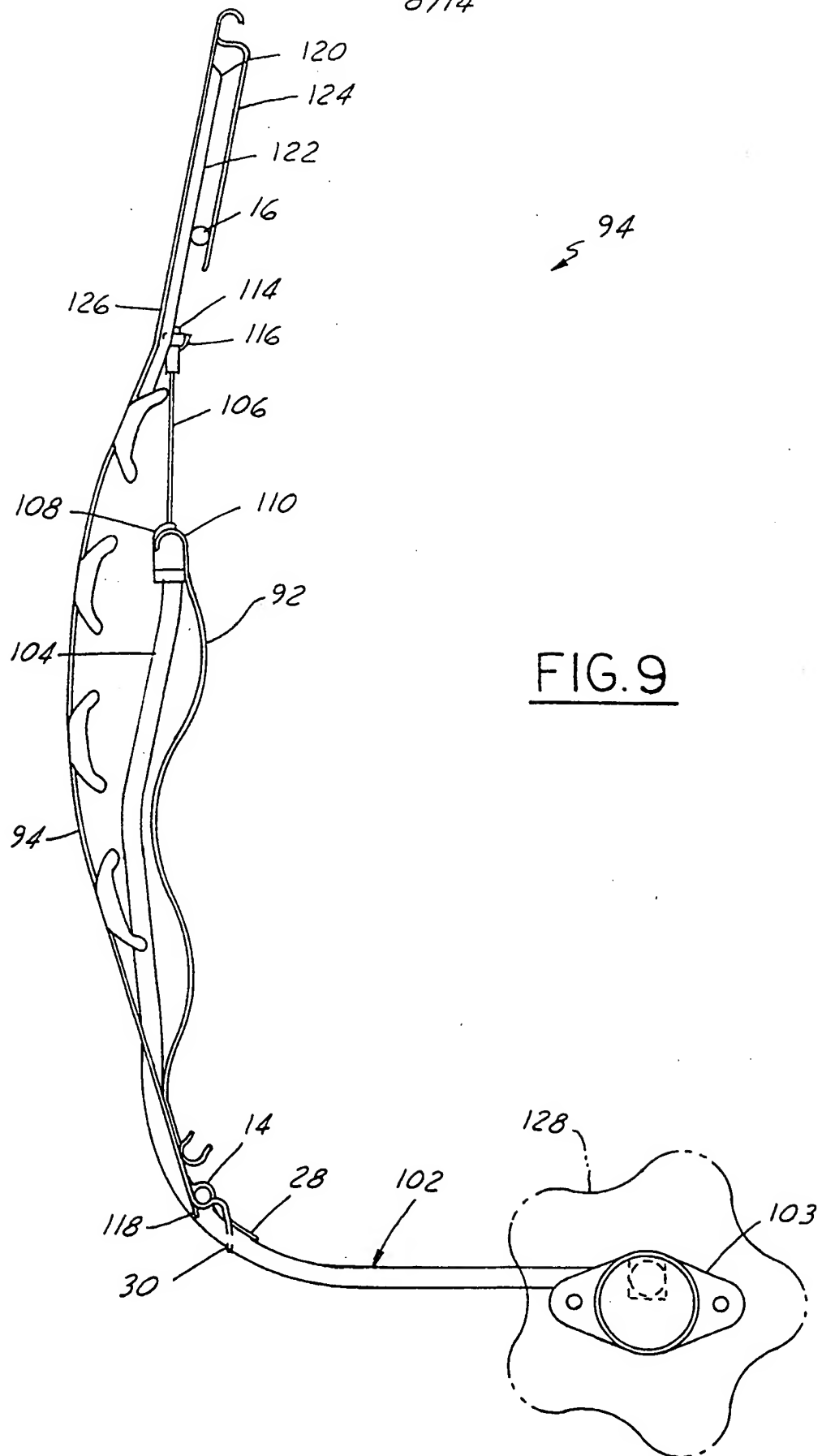


FIG. 8

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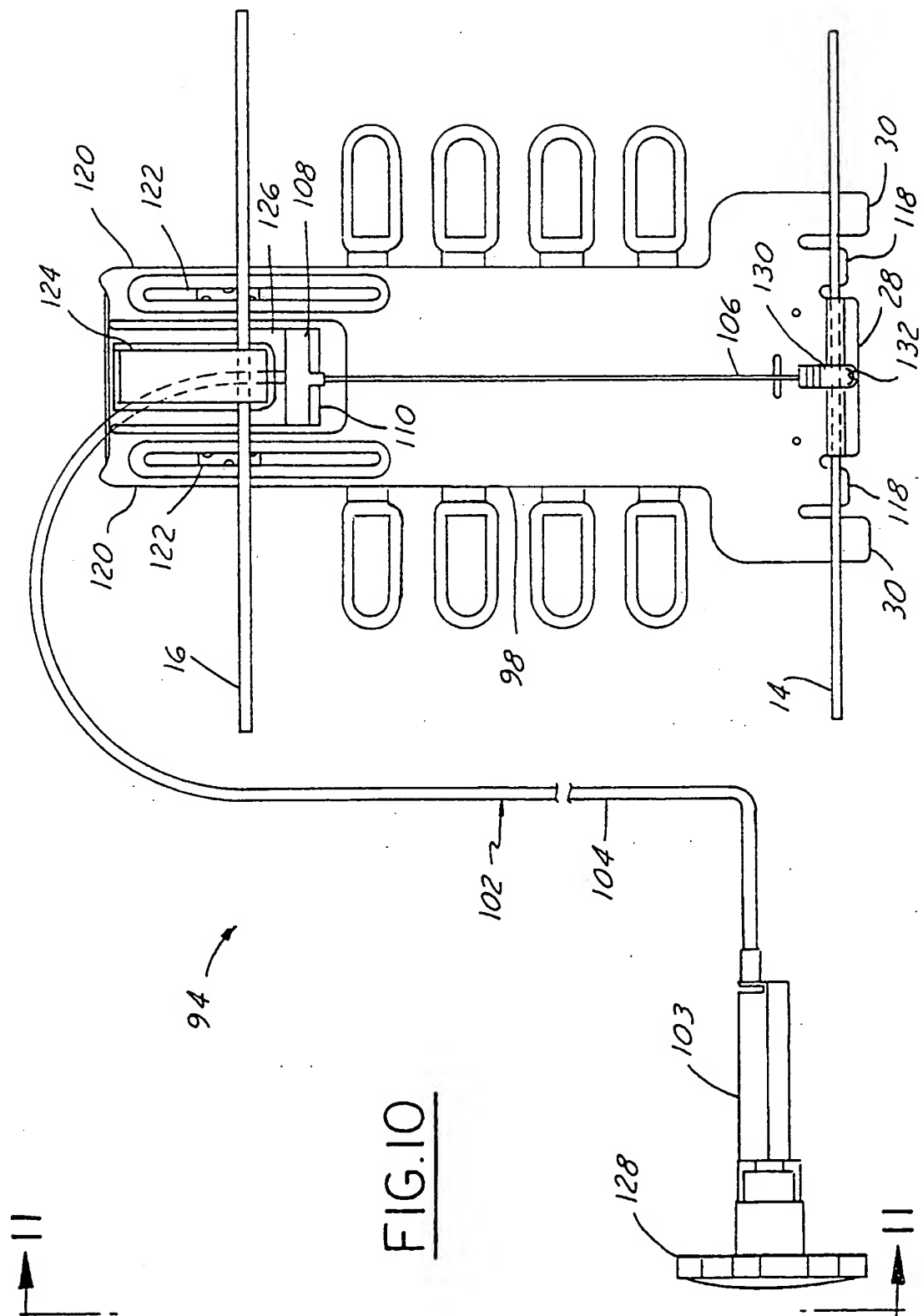
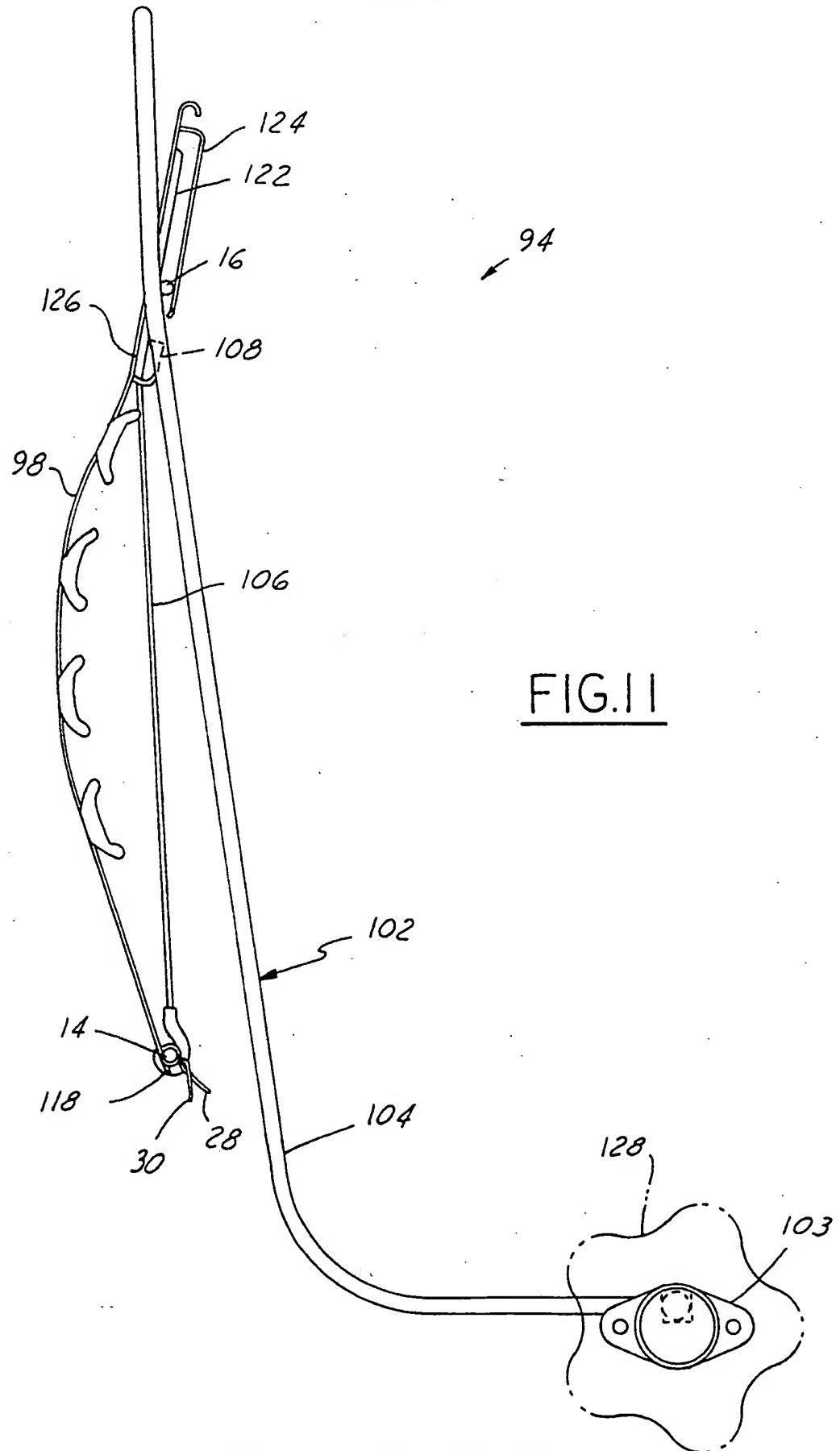


FIG. 10

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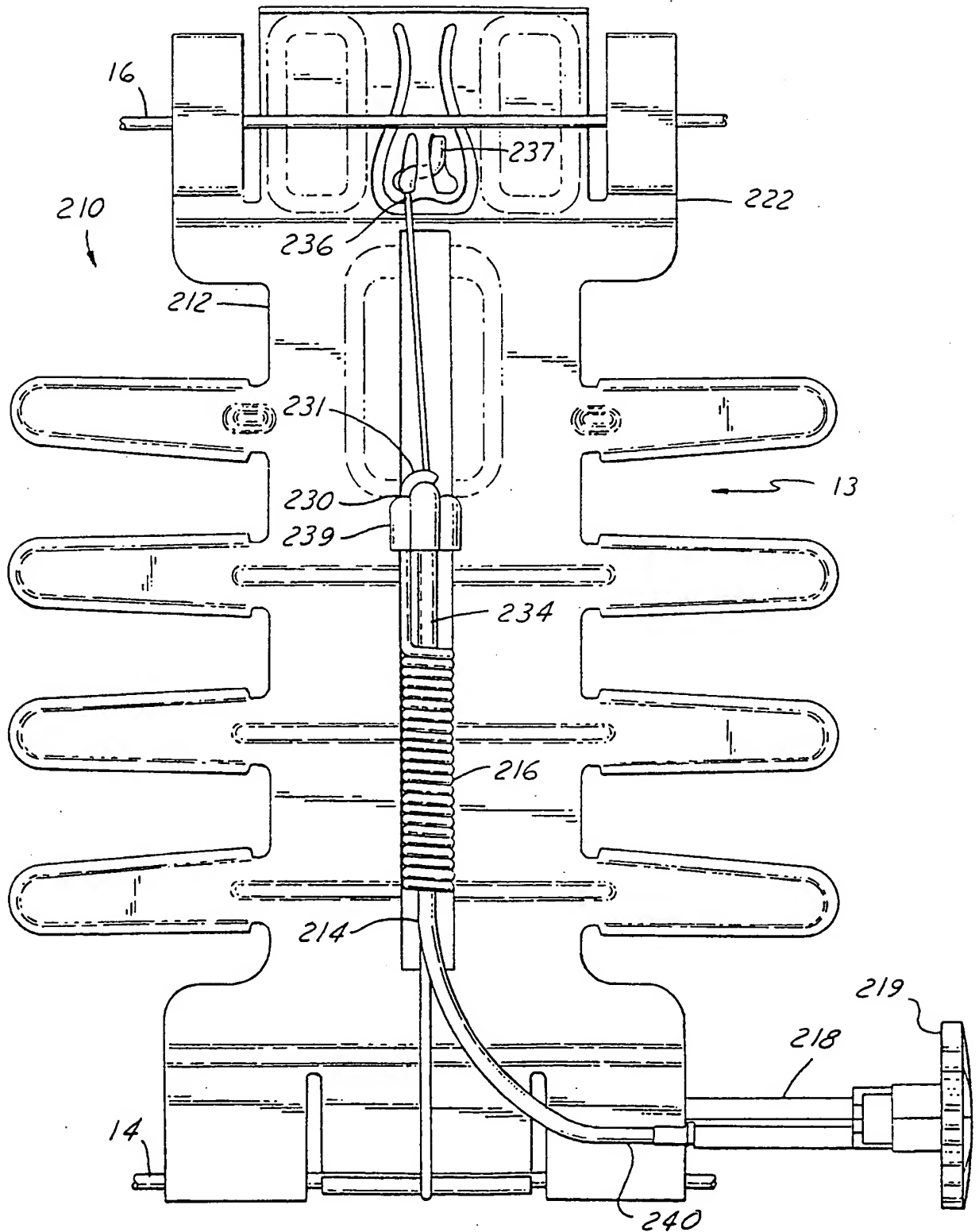


FIG. 12

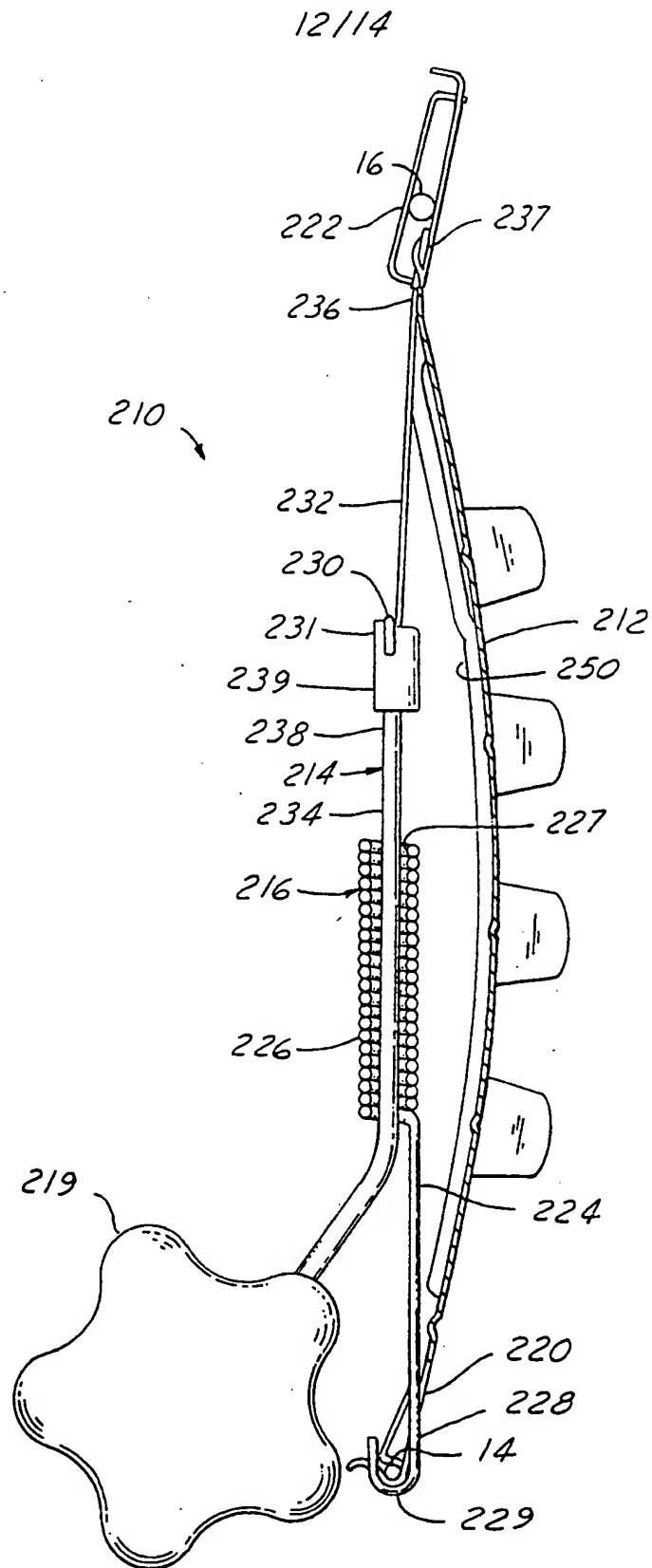
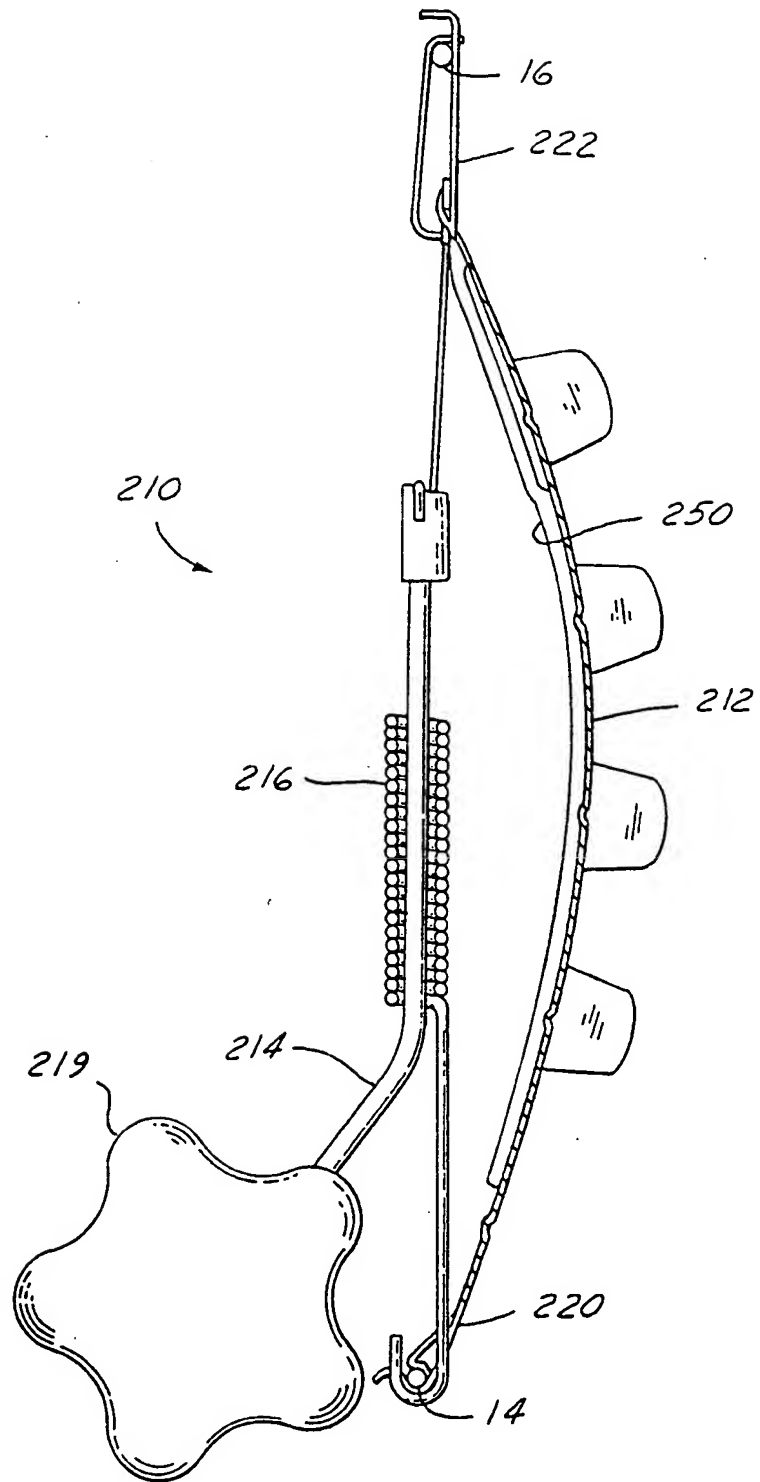


FIG. 13

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FIG. 14

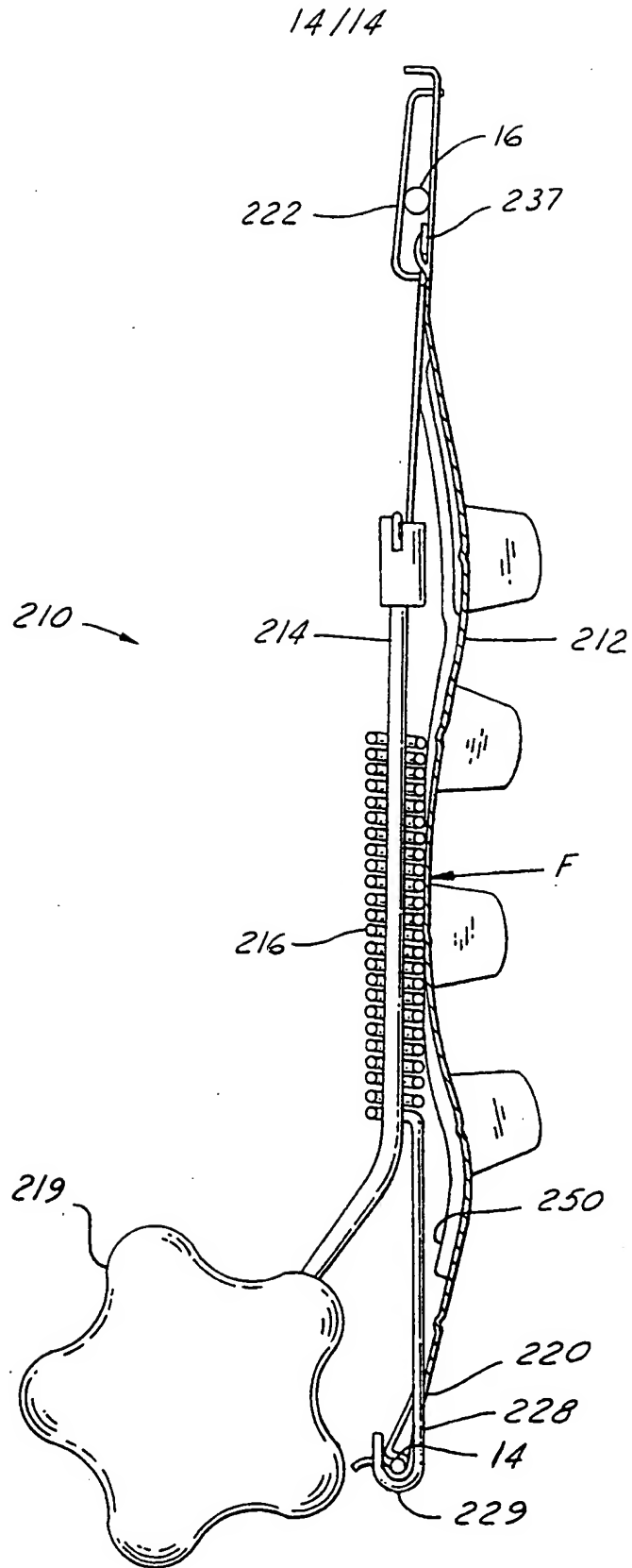


FIG. 15



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/14610

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(6) : A47C 3/025 US CL : 297/284.4 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) U.S. : 297/284.4, 284.1, 452.3 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched None Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) None		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y - A	US 4,316,631 A (LENZ ET AL) 23 February 1982 (23/02/82), see entire document.	1, 2, 5, 6, 9, 10, 13, 14 - 3, 4, 7, 8, 11, 12, 15, 16
X - Y	US 5,217,278 A (HARRISON ET AL) 08 June 1993 (08/06/93), see entire document.	5, 13 - 1, 2, 6, 9, 10, 14
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family	
*O* document referring to an oral disclosure, use, exhibition or other means		
*P* document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 04 AUGUST 1999	Date of mailing of the international search report <b>25 OCT 1999</b>	
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer <i>Dean Gordon</i> MILTON NELSON, JR. Telephone No. (703) 308-2168	